21ST ANNUAL FREEDOM ELEMENTARY

STEM FAIR

TUESDAY, FEBRUARY 20, 2024
6:00 PM - 7:30 PM

REGISTER AT FREEDOMPTA.ORG

Questions?
stemfair@freedompta.org

Welcome, Explorers!

…and the intrepid adults that have been invited on this adventure!

It is time for you to step out into the big, beautiful world and take a look around because **science is all about making sense of the world around you**.

Have you ever…

…followed a line of ants to see where they were going? That's **SCIENCE!**

…shaken a can of soda to see how far it will spray? Also **SCIENCE!**

…made a blanket fort big enough for the whole family? More **SCIENCE!**

…thrown rocks in a pond to see how big a splash it makes? You guessed it… **SCIENCE!!!**

You have been doing science your whole life and didn't even know it. How awesome is that?!

Are you ready to do some more?

A note to the intrepid adults who have joined this exploration:

Thank you for supporting your explorer on their way to becoming a scientist. When we encourage students to explore their world, we encourage them to be lifelong learners. If science is about making sense of the world around us, the scientific method is the framework with which we do so. As we move through the twenty-first century, science and technology continue to advance and evolve at a rapid pace. Students who understand these fields of study will be well prepared for higher education and career advancement. By the end of this project, students will be better able to gather information, think critically, create a logical plan, apply math skills to real life situations, summarize what they know, create a presentation and speak coherently to others.

Please remember that the STEM Fair is an opportunity for students to learn by doing. At the fair, students will be expected to talk to members of the community about their experiments. It is not a competition and all students will be rewarded for their participation. We encourage you to provide guidance on skills that have not been mastered, such as researching, organizing, and typing. However, it is important that the students are challenged throughout the course of this project and that the project is reflective of an elementary student's work. Let the students learn by doing as much as possible.

Safety First!

1. Always have adult supervision when performing an experiment.
2. Dress appropriately - Tie long hair back. Wear closed-toe shoes. Use safety goggles if there is a possibility of eye injury.
3. Wash your hands before and after working on your experiment.
4. Never eat or drink while doing an experiment.
5. Keep your work area clean and clean up any spills as soon as possible. Dispose of waste properly.
6. Do not touch, taste, or inhale chemicals or chemical solutions. Do not use bleach, ammonia, or dangerous chemicals in your experiment.
7. Do not experiment with explosives, combustible materials, firearms, prescription drugs, illegal drugs, tobacco, cannabis, alcohol, or any illegal and/or dangerous substances.
8. Respect all life forms - Animals are not allowed to be used in experiments. Do not perform any experiments that could cause harm to a person or animal.
9. If you want to do an experiment with bacteria/mold, each test sample needs to be completely sealed in a clear plastic bag or container. Do not open the plastic bag or container once it has been sealed. DO NOT bring any samples to the STEM Fair.
10. Use the internet wisely and safely. Make sure all information is gathered from reputable websites. Do not give out personal information online or contact strangers without permission from a responsible adult.

Lab Notebook

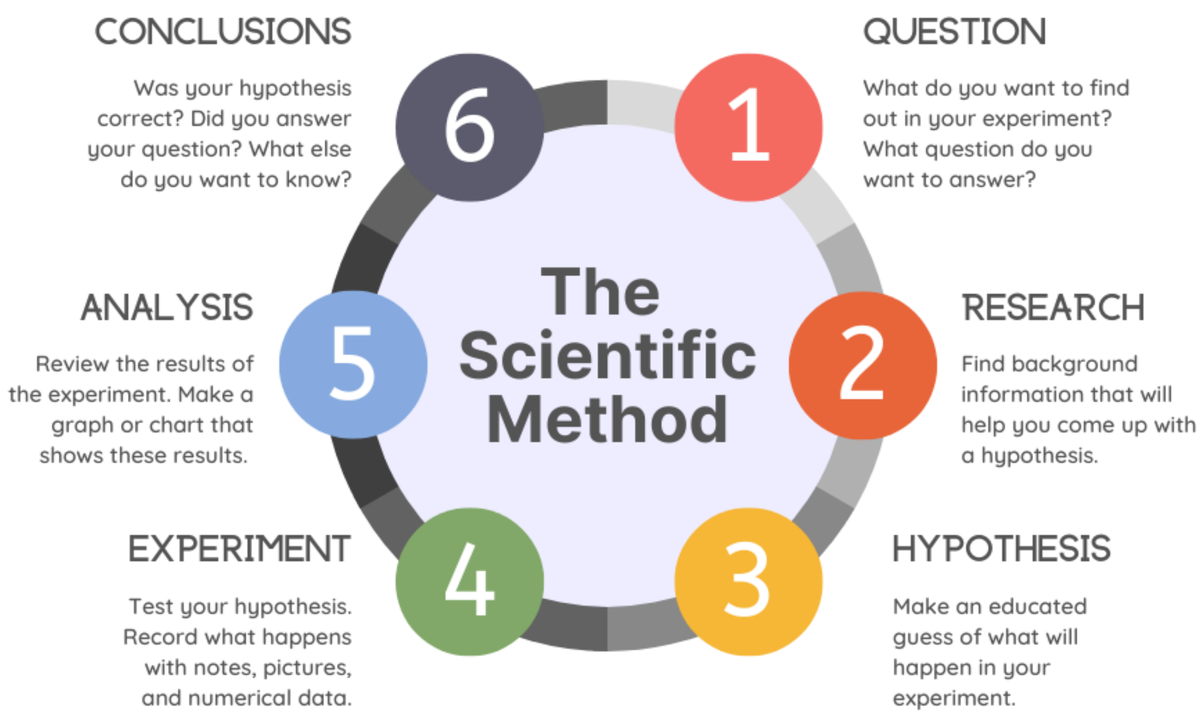
The very first step to becoming a scientist is creating a lab notebook for your experiment. Grab a composition book, journal or spiral notebook and write your name and date on the front cover. Scientists keep A LOT of notes when they are working on an experiment. You will too.

Every day you work on your experiment, add the date and write down what you do. All of your background information, sources, rough drafts, measurements, and design ideas should be included in your lab notebook, even if it's messy or you change it later. This is a record of the process, not a final report. When you get to the

STEM Fair, your lab notebook should be placed on the table in front of your display board. It should show all the work you did from your first brainstorming session until the day of the fair.

The Scientific Method

What is the difference between an explorer and a scientist? An explorer goes out in the world and observes what is happening. A scientist asks questions about those observations and creates experiments to figure out how and why those things happen.



ASK A QUESTION

Take a look at the world around you and find something that interests you. There are a lot of great websites and books out there just teeming with ideas and information.

The STEM Fair committee has also put together a list of project ideas based upon the science units taught at Freedom Elementary. Think back on the science units you have done in school. Do you remember any that were particularly fun and interesting?

Once you have decided what topic you want to study, it's time to come up with a testable question. This can be tricky!

A good question contains two important pieces of information. First, the question has to state what factor will change (variable). Second, the question has to state what will be measured in the experiment (measurement).

The Effect Question

Question: What is the effect of ______________________ on ______________________?

Example: What is the effect of **salt** on **how quickly ice melts**?

Variable: salt/no salt (beginners), different amounts of salt/no salt (advanced)

Measurement: time it takes for ice to melt

The Affect Question

Question: How does ______________________ affect ______________________?

Example: How does the **height of a ramp** affect **how fast a ball rolls**?

Variable: high/low height of a ramp (beginners), various heights (advanced)

Measurement: speed of the ball

The Which/What Question

Question: Which/What ______________________ (verb) ______________________?

Example: Which **seed** sprouts **fastest**?

Variable: 3 types of seeds (beginners), 2-4 types of flower/veggie/fruit seeds (advanced)

Measurement: number of days before sprouting

For our older students who have studied the scientific method in more depth, please note the following vocabulary should be used during your project:

independent variable - what is being tested (variable that you change)
dependent variable - what is being measured (the result of the change)
control group - one group that does not receive the independent variable
experimental group(s) - group(s) that receive the independent variable

Please make sure that your experiment is not a survey of opinions or preferences. Do not test whether people prefer different brands of apple juice. Instead, test if the color of the juice makes it more difficult for people to identify its flavor. (Also, no model volcanoes or solar systems!)

Fair Test

Before moving on to the next step, there is one more point to examine. Will your experiment be a fair test? This means that the ONLY variable that will change in your experiment is the one in your question.

Example: What effect does salt have on how quickly ice melts?

Variable: salt on ice, no salt on ice

Things that must be the same: water source, amount of water, water containers, when the water goes in the freezer, the location inside the freezer, freezer temperature, time in the freezer, when ice is removed from the freezer, when the test takes place, where the test takes place, etc.

Since this experiment involves heat, it should be completed in an area that is not affected by different air temperatures. So, if the oven or stove has been on recently, or the clothes dryer is running, or your lab station is directly next to a heat vent, choose a different location or time to complete your experiment.

STOP AND CHECK

- Is your topic interesting?
- Is your topic age appropriate?
- Are there three or more sources of information on your topic?
- Do you have only one variable?
- Do you know what you will be measuring?
- Is it a fair test?
- Is it safe?
- Do you have the materials or can you obtain them quickly with little cost?
- Do you have enough time to complete your experiment before the STEM Fair?
- Do you have enough time to repeat the experiment more than once?
- Does your experiment follow the safety rules and regulations?
- Have you gotten your teacher's approval of your question?

DO YOUR RESEARCH

Now that you have a topic and question, it's time to gather more information. Look for books, magazines, encyclopedias, community experts, and websites that specialize in your topic. Don't forget to log in to **Clever** with your school email and password. From the main page, you can visit PebbleGo, Discovery Education, and the BrainPOP applications.

You will need to **find at least three sources of information** for your project. As you gather information, make sure to take notes and write down any new vocabulary. Don't forget to write down the following information about your sources so you can add them to your display board:

Books: title, author, page numbers used, publisher, publication date
Magazines: magazine title, volume number, title of the article, page numbers used
Encyclopedia: name, volume
Internet: website address, article title (if available), date accessed

MAKE A HYPOTHESIS

Once you have gathered all your background information about your topic, it is time to make a hypothesis. A hypothesis is an educated guess - what you think will happen in your experiment - based upon all that you have learned through your research. Your hypothesis should include the same text as your question, just stated in a different way and with a little more information.

Question: What effect does **salt** have on **how quickly ice melts**?

Hypothesis: I predict that **salt** will make **ice melt faster** because salt is often applied to icy roadways to help melt the ice and make it safe for cars to drive.

By stating your hypothesis in this way, you show that you know what you are testing, what you are measuring, and what research you have gathered that supports your thinking.

REMEMBER!

Even if you have done the most thorough research possible, there is a possibility that your hypothesis is wrong. THAT IS OK! In science, it is just as important to find out something is false as it is to find out something is true. All knowledge is important and every experiment teaches us something.

TIME TO EXPERIMENT

Gather Materials

Make a list of the materials you will need to complete your experiment and gather everything in a safe place that will not be disturbed. When describing your materials, be as specific as possible, including quantities and measurements wherever possible.

Example: For the question "What effect does **salt** have on **how quickly ice melts**?" my materials would include:

10 mL distilled water for each ice cube

100 mL graduated cylinder
2 blue plastic ice cube trays
Freezer set at 0 degrees Fahrenheit
1 mg iodized table salt
stopwatch

In the experiment above, the stopwatch is used to measure the amount of time it takes for the ice cubes to melt. Not all experiments will need a stopwatch. Think about what measurements you need and make sure you have the right tools ready so you can make those measurements when they are needed.

Write Procedures

Imagine you are setting up your experiment. Write down everything you do, step-by-step, as you set up your experiment with the materials you gathered. Take a picture of each step to include with your final display.

Next, imagine you are starting your experiment. How will you set up your different tests? Is everything the same except for the one variable you are testing? Write the steps you take and how many times you repeat each task.

Finally, think about what you need to measure and how to do it as accurately as possible. Write down what tools you will use to measure and what measurements you will take. Once this is complete, write up the procedures, step-by-step, so that another person could read your directions and perform the same experiment without your assistance.

TEST, TEST, TEST

Once you have finished the procedures, it is time to do your experiment and record what happens. Whenever you need to take measurements or observe the progress of your experiment, always record the date, make observations, and take a picture. Keep your notebook close at hand and write down information as soon as possible so you do not forget.

Every test should be performed 3 or more times to make sure the results are consistent. If you perform the test and get very different results from one to the next, then something is wrong. There might be an error in your design or one of the materials you used is faulty. It might take a little bit of troubleshooting, but finding the problem and fixing it will make your experiment better in the long run. If your experiment is easy to replicate, do more than just 3 trials! The more times you run the experiment, the more reliable and accurate your results.

ANALYZE THE RESULTS

The results section of your experiment should include a neat and organized recording of all the data you collected. There are several different ways to show your results. For your STEM Fair project, the results should either be hand drawn neatly on graph paper or printed using Microsoft Excel, Google Sheets, Numbers (Apple), or other graphing software.

Table

A table is often used by scientists during an experiment to record measurements for each test. Each table should ALWAYS have a title (in bold) and ALWAYS have labels or headings that tell you what is in each column and row (gray boxes). If there are more than one table or graph, they should be labeled in order (Table/Graph 1, Table/Graph 2, etc.).

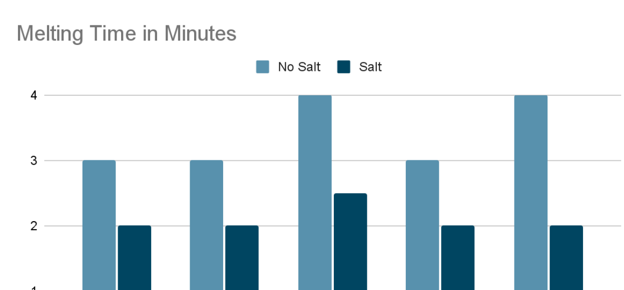
Table 1: Melting Times of Ice Cubes

Trial Number	Control Group	Minutes to Melt		Variable	Minutes to Melt
1	no salt	3		salt	2
2	no salt	3		salt	2
3	no salt	4		salt	2.5
4	no salt	3		salt	2
5	no salt	4		salt	2

Bar Graph

A bar graph is a great way to compare different amounts in an easy to read way.

Bar Graph: Melting Times of Ice Cubes

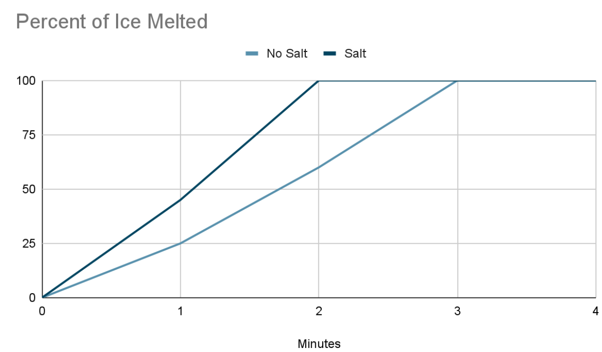


Usually the x-axis (horizontal length along the bottom of the graph) is where you label what is being measured and the y-axis (vertical height on the left side of the graph) is where you put the measurements. If you use this type of graph, make sure to include a title, labels for both the x-axis and y-axis, and a legend if necessary.

Line Graph

A line graph is often used to show how changes occur over a period of time. The x-axis represents the amount of time that has passed, whether it is measured in seconds, minutes, hours, or days. The y-axis represents what is being measured at each of those time intervals. To make it a line graph, each data point (time unit, measurement) should be added to the graph as a single dot and then connected to form a line. Make sure to add a title, labels for the x-axis and y-axis, and a legend if necessary.

Line Graph: Percent of Ice Melted



DRAW CONCLUSIONS

The conclusion section is a summary of your experiment and a reflection on what you learned. Here are some of the questions you can address in your conclusion section:

- What was the purpose of your experiment? (what were you trying to figure out)
- How did you test your hypothesis? (brief overview only)
- What were the results of your experiment? Was your hypothesis correct?
- What should your next steps be to further your experiment or fix mistakes?
- What other information did you learn? What worked? What didn't work?
- How can this information be used in the real world?

Preparing Your Presentation

Now that your experiment is complete, it is time to put all that hard work on display. STEM Fair projects are typically displayed on a tri-fold board that is free standing and no more than 48” wide. Display boards can be homemade or found in either the office supply, school supply, or craft sections of many stores, including Staples, OfficeMax, Wal-mart, Michael’s, and Hobby Lobby. Display boards are available in different colors and are typically made out of cardboard, foamcore, or plastic. There are no restrictions on what colors or materials you use as long as the display is freestanding and no more than 48” wide.

When putting your presentation together, it is very important to be neat and organized. This is the first thing someone will see when they approach your display. Do you want your project to look like it was done at the last minute and hastily slapped together? No. You want your display to look like you took your time and cared about doing your best. Here’s how to do that:

Title

At the top center section of your display should be a title that describes your experiment. It does not have to be in the form of a question. It should be simple and easy to read. Below the title should be a space with your first name, grade level, and homeroom teacher’s last name.

Sections

There should be 8 sections displayed on your board. Each section corresponds to a step of the scientific method that was addressed earlier in this handbook. They are:

- **Purpose** - your original question or description of a technology demonstration goes here
- **Hypothesis (if an experiment)** - your hypothesis goes here
- **Research** - summary of what you learned from your sources about your topic
- **Materials** - list the materials used, be specific with amounts, sizes, etc.
- **Procedure** - make a numbered list of the steps you took to complete your experiments/demonstration
- **Results** - describe your results; add tables, charts, or graphs

- **Conclusion** - write 1 -2 paragraphs about the results and what you have learned
- **Sources** - list your research sources alphabetically

Each of the words in bold above should be used as the heading for each section of your display.

Colors

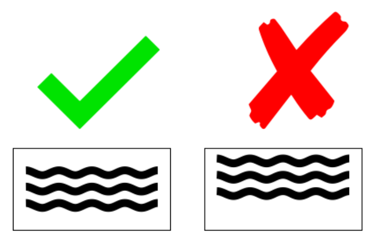
Choose 1-2 colors that are easy to read from a distance. These colors should be used for titles, background frames, and graph components. Dark and bright colors should be used on white backgrounds, while light colors will show up well against dark backgrounds.

Size

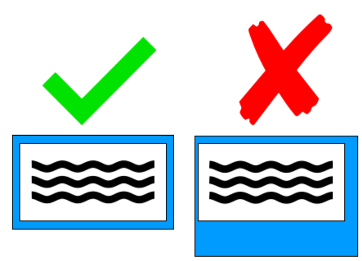
The title should have the largest letters on your board because people will try to read it from a distance. Depending on how many letters are in your title, they should be 3-4 inches tall. The headings for each section should be smaller than the title, but larger than the rest of the text. The headings should stand out so it is easy to follow the project from purpose to conclusion.

Background

When you have finished writing or typing each section of the project, trim the paper so that there is a balanced amount of white space between the words and the edge of the paper.

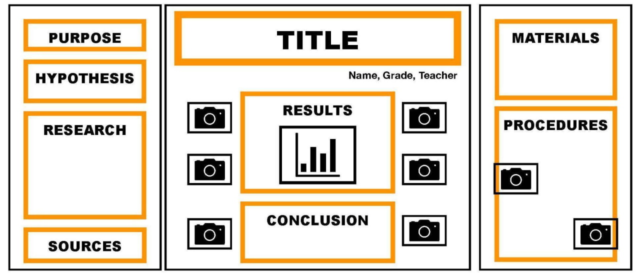


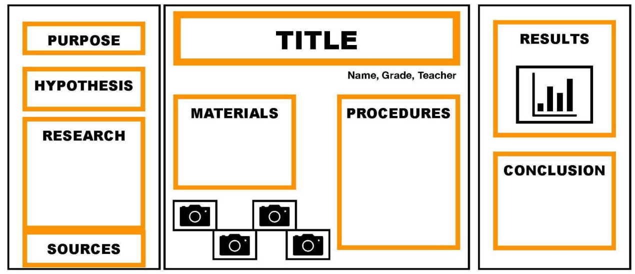
After trimming each piece of paper, place a slightly larger piece of colored paper behind it so there is a border of color surrounding each section of your presentation. This gives your work a very crisp, clean look.



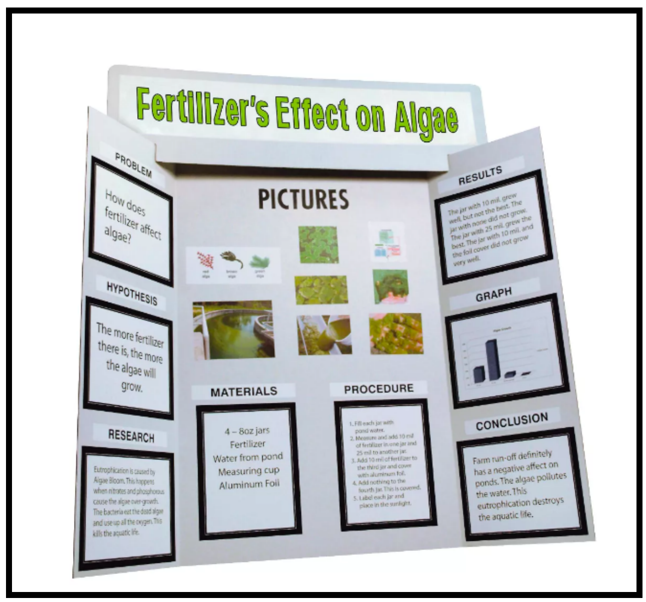
Layout

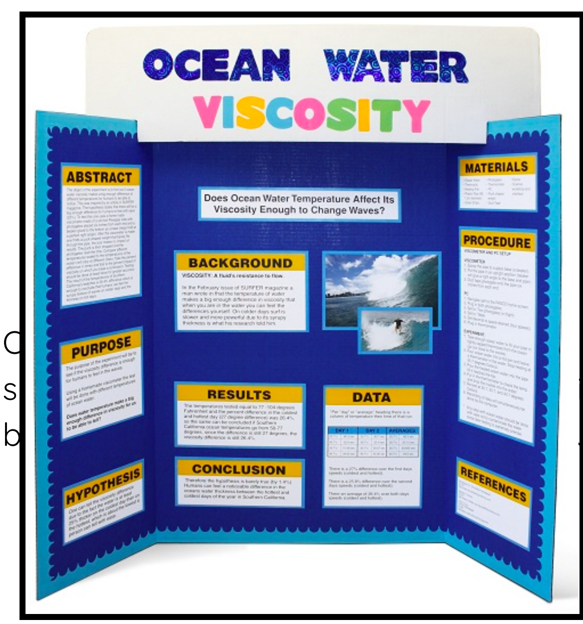
The final step to preparing your display is to lay everything out so it is straight and even, add your pictures, and glue it down. Glue sticks or double sided tape work best for this project. The final layout depends on what you need to fit on the board and what you think looks best. Here are two examples of commonly used layouts for reference.

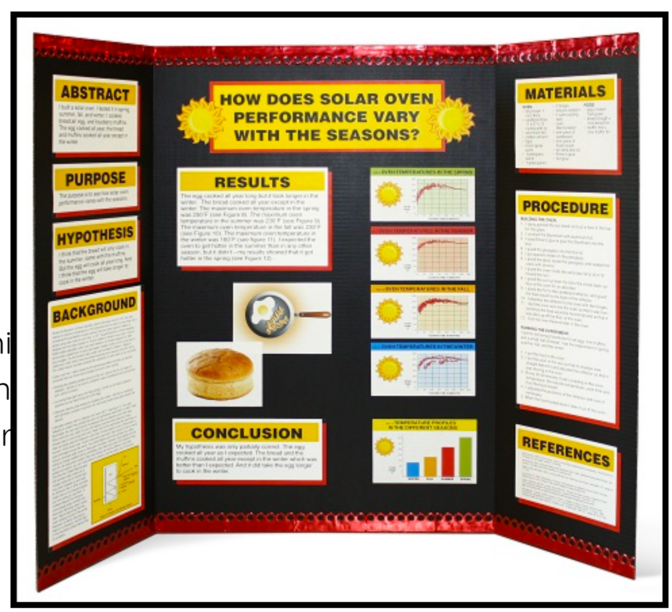




Here are some examples of real STEM Fair projects from Pacon Presentation Boards and Science Buddies:







Checklist

Title
- Legible from a distance
- Related to the topic

Purpose
- Appropriate for the age, grade level, and ability of the student
- Contains a question that can be answered through an experiment or description of a technology demonstration (e.g., solve a problem through coding)

Hypothesis (if an experiment)
- Makes a prediction of what will happen in the experiment
- Includes a reason why the student thinks this will happen

Research
- Explains the reasoning behind the prediction made in the hypothesis or a description of a problem to be solved through a technological or engineering demonstration

Sources
- Sources provided with citation

Materials
- Identifies materials needed to recreate an experiment/demonstration, including quantities

Procedures
- Listed in sequential order
- Shows how to construct the experiment/demonstration through diagrams or photographs
- Experiments are controlled - only one variable changes between the control and test groups

Results
- Explains what happened during the experiment/demonstration
- Provides >1 trial, if an experiment
- Shows what happened through the use of pictures, tables, graphs, or charts including a title, labels, and legend as needed

Conclusion
- Summarizes the overall experiment/demonstration
- Determines if the hypothesis was supported or refuted (if an experiment)
- Suggests ideas for improvement or avenues of further study

Presentation
- Display sections are listed in order of the steps of the Scientific Method
- All text and images are cleanly written/typed, cut out, and attached to the display
- Age appropriate use of vocabulary, spelling, grammar, punctuation and capitalization

All content should be written in the student's own words. Parents should support and help the student but the student should be the driver and primary "do'er."